Title:
Personality Traits of High-Risk Sport Participants: A Meta-Analysis

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Abstract

The purpose of this meta-analysis was to examine the relationships between personality traits and participation in high-risk sport. A total of 149 effect sizes from 39 eligible articles were obtained wherein the personality traits of high-risk sport participants were compared with either low-risk sport participants or individuals not engaged in any sport. Results revealed significant effect sizes in favor of the high-risk participants for sensation seeking, extraversion, and impulsivity. Significant effect sizes in favor of the comparator groups were found for neuroticism, telic dominance, and sensitivity to punishment. No significant differences were observed in psychoticism, sensitivity to reward, socialization, agreeableness, conscientiousness, or openness. The implications of these results and potential avenues of future research are highlighted.

Keywords: Action Sport; Adventure Recreation; Big Five; Extreme Sport; Personality; Sensation Seeking

Personality Traits of High-Risk Sport Participants: A Meta-Analysis

High-risk sports, such as skydiving and rock-climbing (Zuckerman, 1983), are increasing in popularity (Clough, Mackenzie, Mallabon, & Brymer, 2016). Colloquially termed as 'extreme sports', these sports refer to leisure physical activities where the most likely outcome of a mismanaged mistake or accident is severe injury or death (Brymer & Oades, 2009). High-risk sports typically take place outdoors, require cognitive dexterity/originality, courage, and the ability to act in environments that pose a risk to a person's life (Guszkowska & Bołdak, 2010). Zuckerman (1983) classified the risk associated with sport on a continuum from high-risk—wherein the risk of severe injury or death is almost constantly present—to medium-risk—whereby injuries may occur but the risk of fatality is much lower (e.g., boxing, rugby, wrestling)—to low-risk—in which the possibilities of both injury and fatality are even more rare (e.g., golf, bowling). Moreover, while other sports, such as boxing or football, also involve a certain amount of risk, athletes typically compete against each other in controlled environments. In contrast, the environmental conditions (e.g., weather, terrain) of high-risk sports can be unpredictable and impact a participant's success and risk of injury or death. Although high-risk sports incorporate a certain amount of danger, the agency and abilities of the participant play a major role in controlling this risk (Ewert, 1994).

Despite earlier beliefs of the self-destructive nature of these activities (e.g., Hoover, 1978), several benefits of participation in high-risk adventure sports have been found. For example, high-risk sports may help prevent problem behaviour and criminality among adolescents (Hansen & Breivik, 2001) and contribute to the development of humility and courage among participants (Brymer & Oades, 2009). Researchers have even advocated the use of high-risk sports as a mainstream intervention for positive mental health (Clough et al., 2016), as participation in these sports has been shown to be associated with improved quality of life

(Allman, Mittelstaedt, Martin, & Goldenberg, 2009). Hence, given the growing prevalence of participation in high-risk sports and the benefits that these activities can confer, there is a need to examine factors associated with their participation, including an improved understanding of the individuals who are most likely to take part in such activities.

Personality and High-Risk Sport

Previous research has shown that a range of personality traits are associated with participation in high-risk sports (Allen, Magee, Vella, & Laborde, 2016). Several definitions of personality exist; however, most definitions incorporate the notion that personality traits are stable and enduring individual-level differences in tendencies to show consistent thoughts, feelings, and behaviors (McCrae & Costa, 1995). Most research in personality and various types of physical activities has made use of a taxonomy organized by a five-factor model related to higher-order traits of conscientiousness, openness, extraversion, neuroticism, and agreeableness (e.g., Wilson & Dishman, 2015). Studies using this framework have found that, in comparison to low-risk athletes, high-risk sport participants have higher levels of extraversion and openness, as well as lower levels of conscientiousness and neuroticism (Allen et al., 2013; Tok, 2011). Other studies have examined lower-order personality traits, such as sensation seeking (see Gomà-i-Freixanet, Martha, & Muro 2012) and impulsivity (see Castanier & Le Scanff, 2009) in relation to high-risk sport participation.

Various narrative reviews have examined the personality traits of high-risk sport participants, with a particular focus on the sensation seeking trait, which involves the pursuit of varied, novel, complex, and intense sensations and experiences, as well as the willingness to take physical, social, legal, and financial risks for the sake of such experience (Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1994). Overall, higher scores of sensation seeking have been found to be associated with high-risk sport participants to a greater extent compared to low-risk sport

participants or individuals who do not engage in any sport (e.g., Gomà-i-Freixanet, 2004; Malkin & Rabinowitz, 1998). In addition, a literature review by Castanier and Le Scanff (2009) found higher levels of extraversion and impulsivity in high-risk sport participants compared to athletes involved in lower-risk sports as well as non-athletes. However, several higher-order (e.g., neuroticism) and lower-order personality traits (e.g., socialization) of high-risk sport participants have not yet been reviewed and appraised. In addition, despite 70 years of research on the personalities of high-risk sport participants (e.g., Ross, Dancey, & Brown, 1943), no quantitative synthesis of the literature has yet been conducted to estimate the magnitude of associations between any personality trait and participation in these activities. As such, the primary purpose of this meta-analysis was to evaluate the extant literature that has examined the relationships between personality traits and participation in high-risk sport. Specifically, we sought to examine whether high-risk sport participants have differing levels of personality traits in comparison to individuals who do not partake in such activities.

Moderators of the Relationships between Personality and High-Risk Sport Participation

A secondary purpose of this meta-analysis was to examine whether various study characteristics may moderate the relationships between various personality traits and participation in high-risk sport. First, in light of recent calls to examine the quality of studies when conducting systematic reviews (e.g., Elm et al., 2007; Liberati et al., 2009), we sought to examine whether study quality impacted the effect sizes obtained. Second, we sought to determine whether there were any gender differences among effect sizes. Finally, some studies have examined differences in personality among high-risk sport participants in comparison to low-risk sport participants (e.g., Barlow et al., 2013), while others have examined them in comparison to non-sport participants (e.g., Burnik, Jug, Kajtna, & Tuša 2005). As such, we assessed whether there were differential effect sizes based on the type of sample with whom

high-risk sport participants were compared (i.e., low-risk sport participants versus individuals who do not participate in any sport).

Methods

Inclusion/Exclusion Criteria

Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines were followed to determine if articles were eligible for this meta-analysis (Moher, Liberati, Tetzlaff, Altman, & PRISMA group, 2009). Studies were included if they met the following criteria: (1) the study compared the personality traits of high-risk sport participants with a sample of low-risk sport participants or persons not engaged in any sport; (2) the high-risk sport participants had participated in their sport for a minimum of one year; (3) the article was written in English or French; (4) the article was published in a peer-reviewed journal; and (5) the article provided sufficient statistical information to compute an effect size in order to be included in the meta-analysis (if the requisite statistics were unclear in the manuscript, corresponding authors were contacted for this data).

Literature Search

Literature searches were completed in April 2017. The second author and a research librarian specializing in systematic reviews developed an extensive search strategy in order to obtain a comprehensive collection of potential studies (see Appendix A for more details). The following databases most relevant to the topic of psychology and sport were searched: PsycINFO, SPORTDiscus, and Google Scholar. In addition, the snowballing technique was used to search Google Scholar (Haddaway, Collins, Coughlin, & Kirk, 2015). A combination of keywords and their synonyms (show in Appendix A) were used for the terms ‘high-risk sport’ (33 synonyms) and ‘personality’ (121 synonyms). The 33 synonyms for ‘high-risk sport’ were chosen from a preliminary search of articles on this topic (e.g., ‘extreme sport’, ‘adventure

sport'). The 121 synonyms for 'personality' were identified by "exploding" the term of 'personality' on the thesaurus tool provided by PsycINFO. Studies included in six previous relevant reviews (Castanier & Le Scanff, 2009; Gomà-i- Freixanet, 2004; Gomà-i-Freixanet, Martha, & Muro, 2012; Malkin & Rabinowitz, 1998; Roberti, 2004; Zuckerman, 1983) as well as those from the authors' collections of articles were also vetted for eligibility. Finally, the reference lists of studies initially included in the review were manually searched to reveal any additional articles missed by the former search strategies (see Appendix B for a list of all articles included in the meta-analysis).

Data Extraction

Articles were independently coded (categorically) for each potential moderating variable, including: 'type of high-risk sport' (e.g., skydiving, rock climbing, scuba diving); 'gender of participants' (i.e., samples included males only, females only, or males and females); 'personality instrument used' (e.g., Telic Dominance Scale, Sensation Seeking Scale); and 'characteristics of the comparison/control group' (i.e., whether participants from the comparison group included individuals engaged in low-risk sports, or those not involved in any type of sport). Risk was classified according to the criteria by Brymer and Oades (2009), Guszkowska and Bołdak (2010), and Zuckerman (1983). Specifically, high-risk sports were classified as leisure physical activities that require extra originality, courage, and the ability to act in environments that pose a risk to a person's life (cf. Guszkowska & Bołdak, 2010); moreover, the risk of severe injury or death is almost constantly present (cf. Zuckerman, 1983), with the most likely outcome of a mismanaged mistake or accident is severe injury or even death (cf. Brymer & Oades, 2009). Articles were also reviewed for study quality using a scale adapted from the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) initiative statement (Elm et al., 2007). A study received a score from 1 to 6 based on the following criteria: (1) the study provided a clear

description of the samples; (2) the participants were randomly selected; (3) the description of the high-risk sport participant was valid (i.e., minimum of one-year participation); (4) the personality instruments were reliable and valid; (5) the study reported a power calculation or was adequately powered to detect the hypothesized relationships; (6) the study reported attrition rates. The kappa value was 0.51 indicating 'moderate' inter-rater agreement. When discrepancies between author ratings occurred, the two authors met to discuss the article with regard to these differences until they agreed on a common score.

Data Analysis

Treatment effects were estimated using the Hedges' *g* effect size, which is a standardised mean difference metric that corrects for small sample bias (Hedges, 1981). Means and standard deviations were used to calculate Hedges' *g* with the following formula:

$$g^u = g\left(1 - \frac{3}{4(N_T + N_c - 2) - 1}\right)$$

with $g = \frac{X_T - X_c}{s}$ and $s = \sqrt{\frac{(N_T - 1)S_T^2 + (N_c - 1)S_C^2}{N_T + N_C - 2}}$. Here, g^u is the corrected estimate of Hedges' *g*, g is the uncorrected Hedges *g*, N_T is the sample size of the treatment group (i.e., high risk group), N_C is the sample size of the control group (i.e., individuals involved in low risk sport or individuals not involved in any sport), X_T is the mean score of the personality variable in the treatment group, X_C is the mean score of the personality variable in the control group, S is the pooled standard deviation, S_T^2 is the variance of the personality variable in the treatment group, and S_C^2 is the variance of the personality variable in the control group. Calculated this way, effect sizes were coded such that positive values reflect treatment effects in favour of the high-risk group. An effect size of 0.2 corresponds to a 'small effect', 0.5 to a 'medium effect', and 0.8 to a 'large effect' (Hedges & Olkin, 1985).

To meta-analyse effect sizes, inverse variance weighted random-effects models were used for each personality variable. We used random-effects models because they allow inferences about the influence of personality on high-risk sports participation across a variety of procedures and settings (cf. Hedges & Vevea, 1998). To retain as much information as possible, we meta-analysed all eligible effect sizes in each study by permitting studies to contribute multiple effect sizes on each personality variable provided that the sample for each effect size was independent. Several studies reported multiple effect sizes (e.g., examining differences in several personality traits between high-risk sports participants compared to a single control group)—we controlled for these statistical dependencies at the within-study level with robust standard error (variance) estimation (Hedges, Tipton, & Johnson, 2010). This estimation method permits clustered data (i.e., effect sizes nested within samples) to be meta-analysed by correcting the within-study standard errors for correlations between effect sizes. To do so, this method requires an estimate of the mean correlation between all pairs of within-study effect sizes (ρ), which is used to correct the between-study sampling variance (τ^2) for these statistical dependencies. We set $\rho = .80$ because sensitivity analyses revealed that findings were invariant across different reasonable estimates of ρ. Alongside τ^2, we also reported I^2, which quantifies the proportion of effect size variance due to between-sample heterogeneity. I^2 values of 25%, 50%, and 75% reflect low, medium, and high levels of heterogeneity respectively (Higgins & Thompson, 2002).

Inverse variance weighted random-effects meta-analyses with Hedges et al.'s (2010) robust standard error estimation were conducted using the 'robumeta' package in R (Fisher & Tipton, 2015). To test the overall effect of personality on high-risk sports participation, we fitted an intercept only meta-regression model. The constant coefficient in this model has the interpretation of the weighted average effect of personality on high-risk sports participation (Hedges et al., 2010). A positive constant coefficient indicated that the personality variable is

higher among high-risk sports participants, whereas a negative constant coefficient indicated that it is lower.

Next, to test for the possibility that control group type, gender, and study quality explain between-study differences in the weighted average effect of personality on high-risk sports participation, we added several covariates to our intercept only meta-regression models. Control group type was a categorical variable with two categories (low-risk sport = 1, no sport = 2). Gender was a categorical variable with three categories (only males, only females, and combined) and, therefore, we included two dummy covariates for gender. The first—males—reflected the males vs others contrast (coded males = 1, females and combined = 0) while the second—females—reflected the females vs others contrast (coded females = 1, males and combined = 0). When these dummy variables were entered to the meta-regression model, 'combined' was the reference group. Study quality was a continuous covariate that ranged from 1 (low quality) to 6 (high quality). Although we had planned to also examine sport type and personality questionnaire as moderators of the effect sizes for each trait, we were unable to conduct these analyses due to an insufficient number of studies within each category (i.e., fewer than five studies—see below).

The 'robumeta' package in R uses the method of moments estimator to estimate τ^2 (Thompson & Sharp, 1999). As recommend by Tipton (2015), this estimator and its degrees of freedom were adjusted for small sample sizes given that many of our personality variables had a low number of studies. This adjustment notwithstanding, robust standard error estimation with small sample adjustment remains biased (i.e., increased type I error rate) when the adjusted degrees of freedom are ≤ 4 (Tanner-Smith & Tipton, 2013). Accordingly, we do not apply Hedges et al.'s (2010) robust variance estimation or conduct moderator analyses on the weighted average effect sizes of personality dimensions with five or fewer studies. For these dimensions,

we calculated uncorrected weighted average effect sizes from intercept-only random-effects models using the 'metafor' package in R (Viechtbauer, 2010).

Finally, it is recommended that meta-analysts conduct multiple tests to examine potential publication bias (Lin et al., 2018). Three tests were, therefore, carried out in the current meta-analysis. First, a funnel plot of standard error was inspected, which provides a visual depiction of potential bias—publication bias is unlikely when studies are distributed symmetrically about the mean effect size in these figures (Borenstein, Hedges, Higgins, & Rothstein, 2009). Second, the fail-safe N statistic was calculated to estimate the number of unpublished studies with null findings that would be necessary to reduce the effect size to zero (Rosenthal, 1979). If this value is greater than 5n + 10, then the probability of publication bias is low (Rosenberg, 2005). For example, if 20 studies are included, a critical value of 110 studies is required to suggest that publication bias is unlikely to reduce the effect size to zero. Third, Egger's regression test was conducted which examines the association between the observed effect sizes and their standard errors; if the intercept of this regression is a significant, publication bias may be present (Egger, Smith, Schneider, & Minder, 1997; Lin et al., 2018).

Results

[insert figure 1 around here]

Literature Search

We identified 3573 unique articles via database search of PsycINFO, PsycARTICLES, SportDISCUS, and Google Scholar. Following title and abstract elimination, 149 articles were subjected to full-text review. As a result of this review, 110 articles were excluded because they were not published (n = 4), not relevant (n = 35), did not have a comparison group (n = 65), or did not provide sufficient statistics (n = 6). Ultimately, 39 articles met all inclusion criteria and were subjected to meta-analysis. Several articles (k = 31) provided data on multiple comparisons

(i.e., testing the relationship between high-risk sport participation and multiple personality traits). Please see the PRISMA flow chart (Figure 1) for an outline of the search and screening steps.

[insert Table 1 around here]

Study Characteristics

A summary of each article included in the meta-analysis is provided in Table 1. The 39 articles included a total of 149 effect sizes (n = 3584 high-risk sport participants; 2067 control participants) and used cross-sectional/retrospective designs. Twelve personality traits were explored in three or more studies (see below). The most common trait that has been researched in this area is *sensation seeking*, which involves the pursuit of varied, novel, complex, and intense situations/experiences and taking risks for the sake of such experiences (Zuckerman et al., 1994). The 'Big Five' personality traits have also been examined, which include: *extraversion*—having an energetic and assertive approach to the world; *neuroticism*—comprising feelings of tension and nervousness; *agreeableness*—involving a general compliance and positive/kind approach with others; *conscientiousness*—being organized, self-disciplined, and dependable; and *openness to experience*—a sense of curiosity and imagination, or the opposite of close-mindedness (Digman, 1990). *Sensitivity to punishment*—habitual, reactive behaviours in response to cues of punishment, novel stimuli, and non-reward—and *sensitivity to reward*—habitual behaviours reinforced in response to cues of pleasure, success, and rewards (Torrubia, Avila, Moltó, & Caseras)—have also been studied with high-risk sport participants. Research has also been conducted on: *impulsivity*—acting on impulse with little or no forethought, reflection, or consideration for consequences; *psychoticism*—being reckless, non-conformist, angry, or aggressive; and *socialization*—demonstrating altruism, empathy, cooperation, and impulse control (Eysenck & Eysenck, 1976; VandenBos, 2007). Finally, the relatively less commonly-known trait of *telic dominance*—feeling and acting in a light-hearted and playful way in any

given moment—has been studied in relation to high-risk sport participation (Cogan & Brown, 1999).

Regarding potential moderating variables, the control groups consisted of low-risk sport participants in 17 studies and non-sport participants in 22 studies. Two studies were conducted with female participants exclusively and 18 studies were conducted with male participants exclusively, while the remaining 19 included both males and females (combined). Study quality was a continuous variable scored on all studies from 1 to 6 according to the STROBE initiative statement (Elm et al., 2007). A wide array of high-risk sports were studied, including skydiving (n = 8), mountaineering (n = 8), snowboarding (n = 4), skiing (n = 3), scuba diving (n = 3), hang-gliding (n = 3), wakeboarding (n = 2), BASE jumping (n = 1), windsurfing (n = 1), ocean kayaking (n = 1), parkour (n = 1), parasailing (n = 1), rock climbing (n = 1), and surfing (n = 1). The included studies made use of 32 different personality questionnaires. Although (as previously mentioned) we were unable to examine sport type and personality questionnaire as moderators, for descriptive purposes, information on these two variables for each study is provided in Table 1.

[insert table 2 around here]

Overall effects of personality on high-risk sports participation

Weighted average effects with robust variance estimation. We fit intercept-only meta-regression models using robust variance estimation for each personality dimension with more than five studies (see Table 2). For sensation seeking (64 effect sizes from 34 studies), analyses revealed a large weighted average effect size in favor of the high-risk group (Hedges' g = .80, $p <$ .001). Between-study heterogeneity was small (τ^2 = .04) with approximately 14% (I^2 = 14.15) attributable to systematic (i.e., methods and settings) error. For extraversion (17 effect sizes from 10 studies), analyses showed a small-to-medium weighted average effect size in favor of the

high-risk group (Hedges' g = .39, $p < .05$). Between-study heterogeneity was small ($\tau^2 = .05$) with approximately 20% of variance attributable to systematic error. With regard to neuroticism (14 effect sizes from nine studies), analyses revealed a moderate weighted average effect size in favor of the control group (Hedges' g = -.44 $p < .01$). There was no between-study heterogeneity ($\tau^2 = 0.00$). Finally, for impulsivity (12 effect sizes from seven studies), there was a small weighted average effect size in favor of the high-risk group (Hedges' g = .26, $p < .05$). There was also no between-study heterogeneity ($\tau^2 = 0.00$).

[insert table 3 around here]

Uncorrected weighted average effects. We fit intercept-only meta-regression models using uncorrected standard errors for each personality dimension with less than five studies (see Table 3). Weighted average effect sizes for psychoticism, sensitivity to reward, socialization, agreeableness, conscientiousness, and openness were not significantly different from 0 ($p > .05$). Sensitivity to punishment (six effect sizes from six studies) had a moderate weighted average effect size in favor of the control group (Hedges' g = -.44, $p < .01$). Likewise, telic dominance had a medium-to-large weighted average effect size in favor of the control group (Hedges' g = -.61, $p < .01$). There was no between-study heterogeneity observed in effect sizes across all of these eight personality traits.

Moderation of average weighted effects

The second purpose of this study was to examine whether study-level moderators predicted between-study heterogeneity of effect sizes among personality dimensions with more than five studies (see Table 3). Results from intercept-only models indicated that there was no between-study heterogeneity in the effect sizes of neuroticism and impulsivity. As such, we did not conduct moderation analyses on these personality dimensions. For sensation seeking and extraversion, the variance attributable to systematic error (e.g., measures and settings) was small

($\tau^2 < .05$ and $I^2 < 15\%$). Nonetheless, for sensation seeking, the type of control group did have an impact on the weighted average effect size. Here, comparisons with non-sports participants yielded larger effect sizes for sensation seeking than comparisons with low-risk sports participants ($b = .34$, $p < .05$). No other moderation effects (i.e., including participant gender and study quality) emerged.

Publication Bias

With regard to potential publication bias for sensation seeking, extraversion, neuroticism, and impulsivity, fail-safe N and Egger's test statistics are provided in Table 2 while funnel plots are also provided in Appendix C. The fail-safe N for sensation seeking, extraversion, and neuroticism exceeded Rosenberg's critical value (5n + 10), indicating that publication bias is unlikely to reduce the effect sizes of these three traits to 0. However, the fail-safe N did not exceed Rosenberg's value for impulsivity. Regarding Egger's regression test, the intercept was not significant for sensation seeking, extraversion, and impulsivity but was significant for neuroticism. Taken together, the results for neuroticism and impulsivity should be interpreted with caution as publication bias may be present.

Discussion

This study was the first meta-analysis to evaluate the relationships between personality traits and participation in high-risk sports. A comprehensive understanding of these relationships can be applied to adventure tourism marketing efforts (McDaniel & Lee, 2006), risk management (Nicholson, Soane, Fenton-O'Creevy, & Willman, 2005), delinquency preventions (Cazenave, 2007), and an expanded understanding of personality traits and physical activity. Based on our review of 39 eligible articles, quantitative summaries for twelve personality traits were obtained. Overall, the extant literature of the personality traits of high-risk sport participants relies on fairly small samples and exclusively on retrospective/cross-sectional designs. Furthermore, although

some personality traits—in particular, sensation seeking—have been studied extensively, research on other traits has been relatively limited despite the apparent significant relationships between these traits and participation in high-risk sports (e.g., sensitivity to punishment, socialization). The remainder of this paper is devoted to discussing the findings of this meta-analysis, first with regard to higher-order personality traits (i.e., extraversion, neuroticism, psychoticism, agreeableness, conscientiousness, and openness to experience) then to the remaining lower-order traits.

Higher-Order Personality Traits and High Risk Sport

Previous meta-analyses have shown that the higher-order personality trait of extraversion is correlated positively with participation in physical activity (e.g., Wilson & Dishman, 2015). In comparison to those findings, we also found a positive relationship between extraversion and participation in a range of high-risk sports, with this effect size appearing in the small-to-medium range. This finding may reflect the additional extraverted nature of participation in high-risk sports. For example, rock-climbers are often brought to meet strangers at a rock face and rely on newly minted friendships to keep them safe from falling. Moreover, extraversion tends to be manifested through energetic behaviours—this may also explain our findings in part, since high-risk sports require a substantial amount of energy. Our findings did not vary by the gender of the participants in the included studies, suggesting that the relationships between extraversion and high-risk sport participation are invariant for males and females, a finding that runs counter to the general population (e.g., Feingold, 1994). The findings were also not moderated by type of control group, suggesting that significant differences were found between participants of high-risk sport with both participants of low-risk sport as well as individuals who do not participate in sport.

While previous reviews have found a small, negative relationship between participation in physical activity and the higher-order trait of neuroticism (Wilson & Dishman, 2015), this meta-analysis revealed a significant, medium, and negative effect size between this trait and participation in high-risk sports. Hence, individuals with lower levels of neuroticism seem more likely to participate in high-risk sport. This is perhaps unsurprising since neuroticism is characterized by feelings such as worry, fear, and anxiety. Hence, it would seem reasonable to suggest that individuals who are inclined to experience these types of feelings would be less likely to desire participating in activities that can elicit these feelings. Indeed, participation in high-risk sport requires a calm composure to deal with the serious risks inherent in these activities. For example, skydivers will be more efficient if they are calm while preparing their equipment and exiting the airplane. Individuals who are less adept at demonstrating this composure are perhaps less likely to participate in such activities.

Psychoticism is considered a higher-order trait by Eysenck and Eysenck (1976) and has been likened to a combination of low agreeableness and low conscientiousness (McCrae & John, 1992). While it may be tempting to label high-risk sport participants as reckless and non-conformist, the evidence from this meta-analysis suggests that psychoticism is not actually the case. This null finding is congruent with Rhodes and Smith (2006), who found that psychoticism was not associated with physical activity in general. In other words, high-risk sport participants do not appear to be more reckless, non-conformist, or angry compared to individuals who do not partake in such activities.

Although the higher-order traits of agreeableness, conscientiousness, and openness to experience have been found to be significantly related to participation in general physical activity in previous meta-analyses (e.g., Wilson & Dishman, 2015), these results were not corroborated in the current study of high-risk sport activities. However, it is worth noting that only limited data

(i.e., four effect sizes from three studies for each) are currently available for these variables in relation to participation in high-risk sports. As such, future research is warranted to determine whether the null findings from the current meta-analysis are indeed due to a lack of a relationship between these traits and participation in high-risk sports or merely a result of an insufficient amount of existing research examining these relationships. Considering potential moderators of these relationships (e.g., gender, sport type) would also improve our understanding regarding these personality traits.

Lower-Order Personality Traits and High-Risk Sport

The lower-order trait of sensation seeking has been the most commonly studied personality construct of high-risk sport participants. The large effect size associated with participation in high-risk sport and sensation seeking tendencies found in this meta-analysis is congruent with previous literature (e.g., Gomà-i-Freixanet et al., 2012). This finding may be unsurprising as this trait involves a willingness to take physical risks for the attainment of novel, varied, and intense sensations/experiences (Zuckerman et al., 1994). The search for an optimal level of stimulation has been previously suggested as a good fit for participation in high-risk sports (Zuckerman, 1983). This finding may also be explained, in part, by tendencies for high-risk sport participants to sample a wide selection of activities (Rowland, Franken, & Harrison, 1986). Our results suggest that sensation seeking is indeed a distinctive trait of high-risk sport participants. The results of our moderator analyses suggest that this effect is stronger when these participants were compared to individuals who participate in low-risk sport versus individuals who do not participate in any sport. The results of the remaining moderator analyses showed that these effects did not vary by gender nor by study quality.

Similar to the findings by Castanier and Le Scanff (2009), the lower-order personality trait of impulsivity was also found to be positively correlated with participation in high-risk

sports (to a small extent). Moreover, a negative effect size was shown for sensitivity to punishment (to a medium extent) as well as telic dominance (to a medium-to-large degree). Hence, in comparison to individuals who do not participate in high-risk sport, it appears that those who do may be more likely to act on impulse with little or no forethought, reflection, or consideration for consequences. They (high-risk sport participants) also seem more likely to (a) demonstrate reactive behaviours in response to cues of punishment, novel stimuli, and non-reward, and (b) feel and act in a light-hearted/playful manner at a given moment. Finally, in contrast to the aforementioned differences in lower-order traits, no significant effect sizes were found for sensitivity to reward nor socialization. Thus, at present, it does not appear that high-risk sport participants differ from individuals who do not engage in these sports in terms of exhibiting (a) habitual behaviours in response to cues of pleasure, success, and rewards, or (b) altruism, empathy, cooperation, and impulse control. With exception to sensation seeking and impulsivity, it should be noted that the findings for the remaining lower-order personality traits (sensitivity to punishment, telic dominance, sensitivity to reward, and socialization) were each based on a very small number of studies (three). As such, future research is necessary to provide more conclusive evidence corresponding to these results, as well as to determine whether these relationships vary according to any moderator variables (e.g., participant gender, questionnaires used to measure these traits).

Limitations and Additional Considerations for Future Research

The results of this meta-analysis provide insights into the predominant personality traits of high-risk sport participants. Notwithstanding these contributions, this study is not exempt of certain limitations. For example, the review was limited to English and French articles and did not include the grey literature. In addition, the moderator corresponding to study quality was coded subjectively and, as such, it could be argued that this subjectivity introduces bias due to the

difficulty of effectively judging study quality on a consistent basis. Moreover, we were unable to investigate most personality traits in detail (i.e., beyond calculating a main effect size), which limits the generalizability of the conclusions derived from the study. Other personality traits that have been studied in relation to other types of physical activity were not included in the meta-analysis at all due to a paucity of available studies, such as narcissism and perfectionism. In addition, the cross-sectional design of studies included in the meta-analysis allows us to establish a relationship with personality traits; however, it does not allow any type of causal effects to be inferred. Examining the relationships between personality traits and high-risk sport participation utilizing prospective designs are, therefore, warranted as these types of studies would allow researchers to examine these relationships in further detail. For example, researchers could examine whether certain traits predict the uptake, maintenance, and/or dropout of these activities over time. Moreover, while personality is primarily modeled as an antecedent to physical activity, it would be useful to determine whether continued participation in high-risk sports over time has an effect on trait expression.

By describing a set of individual personality traits that are associated with high-risk sports, this meta-analysis adds breadth to the individual traits that may help explain participation in these types of activities. Although more detailed personality research has begun to emerge (e.g., Thomson, Carlson, & Rupert, 2013), integrated models demonstrating the complex interrelationships between personality traits with other constructs are still needed. While it is plausible that a certain personality profile may predict one's involvement in high-risk sport, several other factors beyond the scope of personality may also be responsible for participation in high-risk sports. For example, the development of mastery (Celsi et al., 1993) and/or an identity associated with high-risk sport (Lynch & Dibben, 2015) may increase an individual's desire to continue participating in these types of sport. It is also possible that other variables beyond those

considered within the moderator analyses covary with participation in high-risk sport and, therefore, may impact the relationship between participation and personality. For example, from a financial perspective, it is quite expensive to partake in many high-risk sports (e.g., skydiving, snowboarding, scuba diving); as such, participant socioeconomic status may be an important variable to consider in future studies of high-risk sport participation. In addition, we were precluded from conducting any type of mediator analyses to better disentangle the relationships between each personality trait and participation in high-risk sport. As such, it remains unclear what exactly is "driving" the associations between personality and high-risk sport involvement. For example, with regard to sensation seeking, the extent to which the associations are due to the positive emotional elements of sensation seeking, the disinhibitory elements, or some other component is not yet apparent. As such, examining the mechanisms of—and potential interactions between—personality and other variables in future studies would add further detail and nuance to our understanding of the individuals who take part in high-risk sports.

Lastly, the resulting effect sizes for two of the personality traits we analyzed—impulsivity and neuroticism—displayed evidence of positive publication bias. In meta-analyses that review several independent contrasts, it is not unusual to find that some are at risk of publication bias (e.g., Curran, Hill, Appleton, Vallerand, & Standage, 2015). It is nonetheless important to recognize that the presence of such publication bias decreases the confidence in findings for these two specific contrasts. Furthermore, some of the subgroup analyses relied on small clusters of studies (i.e., $k < 5$) and, as such, the contrasts from such clusters are more susceptible to reversal by newly conducted studies. Therefore, the findings that display evidence of publication bias and/or emerge from small subgroups should be interpreted tentatively and require especial attention in future research.

Conclusion

Despite sustained study for over 70 years, this is the first meta-analysis to investigate the relationships between personality traits and high-risk sport participation. Furthermore, this review provides the largest breadth of personality traits on the topic when compared to prior narrative reviews, which have focused predominantly on the sensation seeking trait. The evidence from our analyses suggests that high-risk sport participants are more likely to have higher levels of sensation seeking, extraversion, and impulsivity, and less likely to demonstrate neuroticism, sensitivity to punishment, and telic dominance in comparison to individuals who do not partake in such activities. While this meta-analysis has indeed improved our current understanding of the personality traits associated with high-risk sport participation, the data up to this point have been retrospective in nature and many traits (e.g., openness, agreeableness, socialization) require further investigation. Researchers could also consider utilizing longitudinal and prospective designs in order to examine the various interrelationships (including the mechanisms and boundary conditions) between personality and other salient variables that may predict engagement in high-risk sport.

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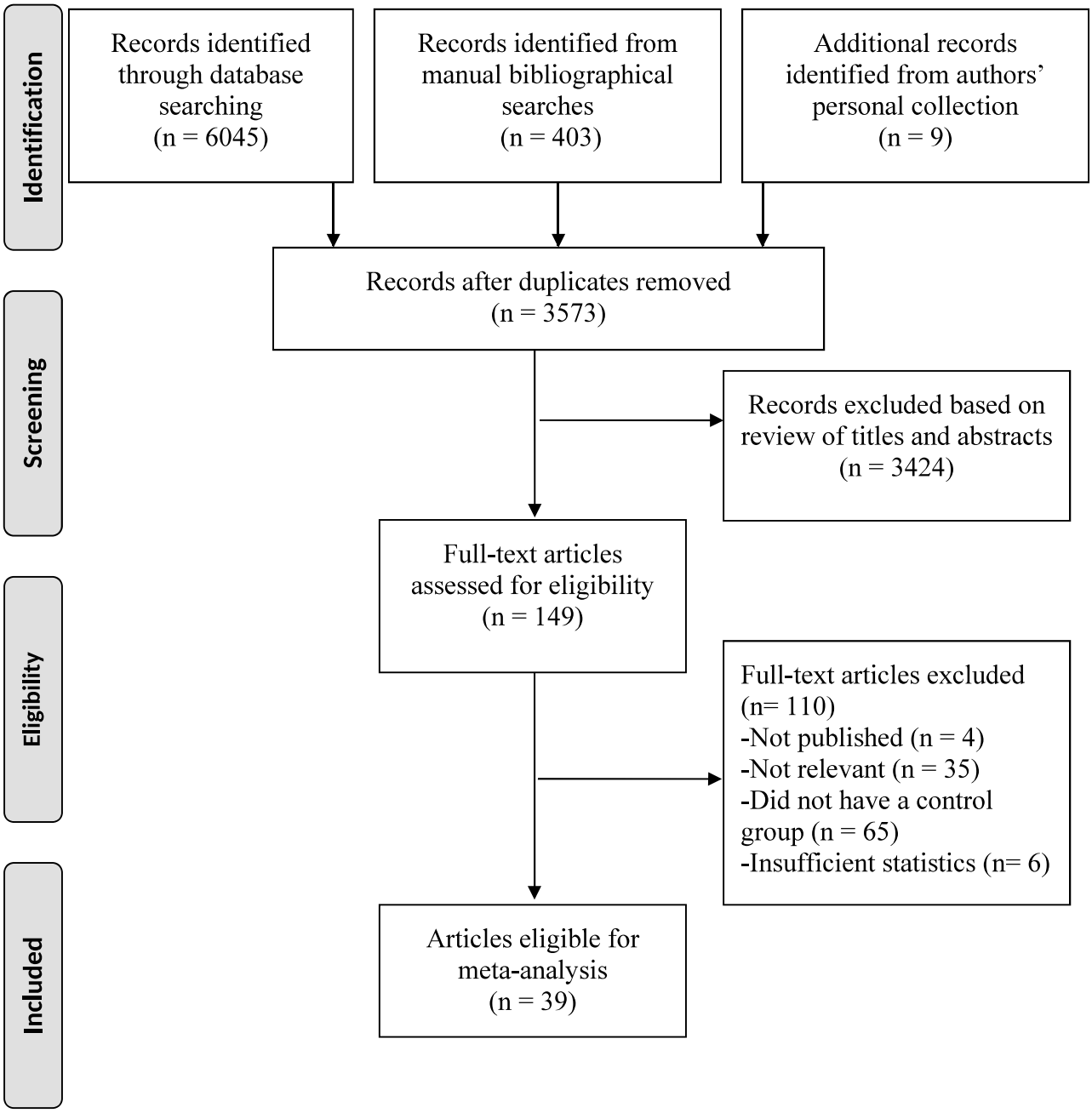

Figure 1. PRISMA Flow Diagram.

Table 1

Summary of the articles included in meta-analysis.

Study	Participant characteristics	Comparison group	Personality questionnaires	Study Quality
Barlow et al. (2013)	Skydivers (36 men, 5 women; age: 30 ± 10), Mountaineers (35 men, 4 women; Age: 30 ± 8)	Low-risk sport participants (31 men, 1 women; age: 36 ± 14)	Sensation Seeking Scale-Form Five (SSS-V); Ten-Item Big Five Inventory	3 (Moderate)
Biersner & Cameron (1970)	Navy scuba divers (20 men; Median age: 28)	Navy enlisted men (20 men; median age: 26)	Minnesota Multiphasic Personality Inventory (MMPI); Edwards Personal Preference Schedule (EPPS)	3 (Moderate)
Blenner (1993)	Skydivers (5 men, 5 women), Hang-gliders (9 men, 1 woman), Rock-climbers (13 men, 1 woman), Scuba divers (2 men, 2 women), Ocean kayakers (2 men, 1 woman), Average HRS participant age: 28 ± 8)	University students not participating in sport (39 age and gender matched controls)	Sensation Seeking Scale-Form Four (SSS-IV)	3 (Moderate)
Breivik (1996)	Everest climbers (7 men; Age: 39 ± 7); Elite climbers (38 men; age: 29 ± 6)	University students not participating in sport (38 men; Age: 23 ± 3)	Cattell's 16 Personality Factor Inventory; SSS-V	4 (High)
Burnik et al. (2005)	Mountain climbers (58 men; Age: 32 ± 4)	Non-athletes (50 men; Age: 27 ± 2)	Freiburg Personality Inventory	2 (Moderate)
Calhoon (1988)	Ski instructors (11 men, 8 women; Age: 18-39)	University students not participating in skiing (10 men, 11 women; Age: 18-39)	Eysenck Personality Questionnaire (EPQ); SSS-V; SSS-VI	3 (Moderate)
Cazenave (2007)	Free runners (36 boys, 11 girls; Age: 14 ± 1)	Gymnasts (30 boys, 15 girls; Aged: 14 ± 2)	SSS-V; Narcissistic Personality Inventory	2 (Moderate)

Cazenave et al. (2007)	Professional HRS participants (37 women; Age: 38 ± 6), Leisure HRS participants (53 women; Age: 27 ± 8)	Low-risk sport participants (90 women; Age: 20 ± 2)	Bem Sex Role Inventory; Barratt Impulsiveness Scale (BIS); SSS-V	2 (Moderate)
Chirivella & Martínez (1994)	Parasailing participants (21 men and women)	Tennis players (30 men and women)	SSS-V; Telic Dominance Scale (TDS); Negativism Dominance Scale (NDS)	2 (Moderate)
Cogan & Brown (1999)	Snowboarders (36 men; Age: 22± 2)	Badminton players (26 men; Age: 22 ± 4)	TDS; NDS; Telic/Paratelic State Instrument	2 (Moderate)
Cronin (1991)	Mountain climbers (9 men, 11 women; Age: 21 ± 9)	University students (8 men, 13 women; Age: 20 ± 2)	SSS-V	2 (Moderate)
Dudek et al. (2016)	Combined HRS participants including: rock-climbers, snowboarders, windsurfers (255 men, 223 women; Age: 26 ± 6)	Low-risk sport participants or controls not engaged in any sport (107 men, 128 women; Age: 28 ± 9)	BIS	4 (High)
Fenz & Brown (1968)	Skydivers (28 men)	University students (28 men)	MMPI	2 (Moderate)
Fowler et al. (1980)	Mountain climbers (11 men, 7 women; Age: 29 ± 5)	University students (18 men, 23 women; Age: 26 ± 5)	SSS-V; EPQ; KSP Impulsivity and Monotony Avoidance subscales	3 (Moderate)
Franques et al. (2003)	Paragliders (34 men and women)	School employees (34 men and women)	SSS-IV	2 (Moderate)
Gomà-i-Freixanet (1991)	Alpinists (27 men; Age: 33 ± 9), Mountain climbers (52 men; Age 31 ± 11), Skiers (20 men; Age 31 ± 11), Combined HRS participants (221 men; Age: 31 ± 9)	Individuals not engaged in sport (54 men; Age: 31 ± 11)	SSS-V; EPQ; Impulsiveness Venturesomeness Empathy Questionnaire (IVEQ); Socialization Scale of the California Psychological Inventory (SOCPI); Susceptibility to Punishment	4 (High)

			Scale (SPS); Susceptibility to Reward Scale (SRS)	
Gomà-i-Freixanet (1995)	Combined HRS participants including: skydivers, scuba divers, hang-gliders (332 men; Age: 31 ± 9)	Individuals not engaged in sport (54 men; Age: 31 ± 11)	SSS-V; EPQ; IVEQ; SOCPI; SPS; SRS	3 (Moderate)
Gomà-i-Freixanet (2001)	Combined HRS participants including: skydivers, scuba divers, hang-gliders (52 women; Age: 28 ± 6)	Individuals not engaged in sport (54 women; Age: 30 ± 6)	SSS-V; EPQ; IVEQ; SOCPI; SPS; SRS	3 (Moderate)
Guszkowska & Boldak (2010)	Skydivers (98 men), Wakeboarders (30 men), Snowboarders (30 men), Scuba divers (22 men), Alpinists (20), Paragliders (17); Average age: 26 ± 6)	Individuals not engaged in sport (54 men; age: 26 ± 6)	SSS-IV	3 (Moderate)
Hymbaugh & Garrett (1974)	Skydivers (21; sex unspecified)	Individuals not engaged in skydiving (21 sex unspecified)	SSS	1 (Low)
Jack & Ronan (1998)	Combined HRS participants including: skydivers, mountain climbers, hang-gliders (83 men, 10 women; Age: 31 ± 9)	Low-risk sport participants 36 men, 37 women; Age: 27 ± 14)	SSS-V	3 (Moderate)
Kajtna et al. (2004)	Combined HRS participants including: Alpinists, skydivers, paragliders, divers, white-water kayakers, downhill bikers, motocross riders, downhill skiers, ski jumpers (38 men; Age: 25 ± 5)	Low-risk sport participants (38 men; Age: 24 ± 4)	SSS-IV; Big Five Observer Scale	4 (High)
Kerr (1991)	Surfers (32 men), Windsurfing (31 men), Skydivers (18 men; Age: 31 ± 9), Hang-gliders (25 men)	Marathon runners (17 men; Age: 34 ± 9)	TDS	2 (Moderate)
Klinar et al. (2017)	Combined HRS participants including: Skydivers, alpinists, divers, downhill	Low-risk sport participants (51 men; Age: 31)	Big Five Questionnaire; SSS-V; SSS-VI	3 (Moderate)

	skiers, ski jumpers (127 men; Age: 24)			
Michel et al. (2009)	BASE jumpers (11 men; Age: 27 ± 4)	University students (11 men; Age: 28 ± 4)	SSS-IV; International Personality Disorder Examination	3 (Moderate)
Migdal (1990)	Mountain climbers (25 men, 5 women; Age unidentified)	Individuals not engaged in sports (25 men, 5 women; Age unidentified)	SSS; State-Trait Anxiety Inventory (STAI)	1 (Low)
Myrseth et al. (2012)	Skydivers (77 men and 16 women (the; Age: 33 ± 10)	Non-pathological gamblers (Age: 34 ± 12)	Arnett Inventory of Sensation Seeking (AISS); Impulsivity Scale	2 (Moderate)
Próchniak (2011)	Skydivers (53 men; Age: 28 ± 10)	Low-risk sport participants (59 men; Age: 27 ± 7)	Zuckerman-Kuhlman Personality Questionnaire	1 (Low)
Rainey (1992)	Hang-gliders (29 men; Age: 30)	Baseball players (39 men; Age: 19)	Sport Competition Anxiety Test; SSS-V	2 (Moderate)
Reuter & Holder (2013)	Combined HRS participants including: Skiing, motocross, snowboarding (46 unidentified participants; Age: 18-48)	Low-risk sport participants (103 unidentified participants; Age: 18-48)	Myers Briggs Type Indicator; SSS-V	3 (Moderate)
Rhea & Martin (2010)	Wake boarders (3 men), Motocross participants (42 men), Drag racer (1 man), Skiers/Snowboarders (4 men); Average age: 22 ± 4.5	Low-risk sport participants (22 men; Age: 27 ± 7)	16 PF; SSS-V	3 (Moderate)
Sanchez & Heyes (2005)	Amateur skydivers (10 men; Age: 27 ± 3.0), Military skydivers (8 men; Age: 30 ± 2)	Individuals not engaged in sports (9 men; age: 27 ± 3)	EPQ; SSS-V	2 (Moderate)
Siwek et al. (2015)	Combined HRS participants including: Rock-climbing, mountaineering, bouldering, diving, free-ride, snowboarding (255 men, 225 women;	Individuals not engaged in sports (107 men, 128 women; Aged 28 ± 9)	Temperament Evaluation of Memphis, Pisa and San Diego Autoquestionnaire	3 (Moderate)

	Age: 26 ± 6)			
Slanger & Rudestam (1997)	Combined HRS participants (20 men) including: Rock climbing, skiing, piloting a small plan, white water kayaking; Age: 38 ± 11)	Athletes involved in lower risk sports (20 men; Age: 38 ± 9)	SSS-V	2 (Moderate)
Thomson & Carlson (2014)	Downhill skiers, snowboarders, mountain bikers (74 men, 48 women; Age: 21 ± 2)	Individuals not engaged in sports (50 men, 54 women; Age: 21 ± 3)	ZKPQ Impulsive Sensation Seeking Scale; Impulsive Behaviour Scale; SPS; SRS; IPIP Big Five	3 (Moderate)
Wagner & Houlihan (1994)	Hang-gliders (170 participants unidentified by sex; Age: 39)	Golfers (90 participants unidentified by sex; Age: 33)	STAI; SSS-V	4 (High)
Watson & Pulford (2004)	Combined HRS participants including: Skydiving, hang-gliding, paragliding, scuba diving, micro lighting, rock climbing (13 men, 7 women; Age; 38 ± 8)	Individuals not engaged in sports (11 men, 14 women; Age: 28 ± 11)	EPQ; Type A/B Personality MHRSure	3 (Moderate)
Zaleski (1984)	Combined HRS participants including: Skydiving, hang-gliding, mountain-climbing (60 men; Age: 18-50)	Individuals not engaged in sports (60 men; Age: 18-50)	SSS-V	3 (Moderate)
Zarevski et al. (1998)	Combined HRS participants including: Skydiving, scuba diving, hang-gliding, alpinism (94 men; Age: 30)	Low-risk sport participants (94 men; Age: 30)	AISS; SSS-V	2 (Moderate)

Note. HRS = High-risk sport.

Table 2.

Weighted average effects with robust variance estimation, moderation analyses, and publication bias

Variable					95% CI			Heterogeneity		Publication Bias	
	k	***o***	***b***	***SE***	**LL**	***UL***	***t* (*df*)**	τ^2	I^2	**Fail Safe N**	**Egger's test [Y(SE), *p*-value]**
Sensation Seeking	34	64								6607	1.23 (1.30),
Intercept Only								.04	14.15		$p = 0.35$
Constant			.80**	.08	.65	.96	10.5 (30.30)				
Moderators								.02	7.78		
Constant			-.13	.47	-1.15	.89	-.29 (12.15)				
Control			.34*	.17	.003	.68	2.11 (18.88)				
Male			>.001	.16	-.33	.33	.002 (20.32)				
Female			.42	.41	-.99	1.83	1.02 (2.65)				
Quality			.20	.19	-.26	.66	1.05 (7.04)				
Extraversion	10	17								153	0.35 (2.48),
Intercept Only								.05	19.50		$p = 0.89$
Constant			.39*	.15	.05	.74	2.61 (8.32)				
Moderators								0	0		
Constant			-.70	.47	-4.04	2.65	-1.47 (1.34)				
Control			.67	.25	-.62	1.96	2.67 (1.70)				
Male			-.28	.27	-.99	.44	-1.02 (4.50)				
Female			.01	.12	-.35	.38	.11 (3.29)				
Neuroticism	9	14								146	-4.81 (1.69),
Intercept Only								0	0		$p = 0.02$
Constant			-.44**	.12	-.71	-.17	-3.81 (7.40)				
Impulsivity	7	12								47	1.26 (1.23),
Intercept Only								0	0		$p = 0.34$
Constant			.26*	.07	.08	.43	3.65 (5.06)				

Note. *k* = number of studies; *o* = total number of comparisons; *b* = coefficient in the meta-regression model; *SE* = standard error of the coefficient; 95% CI = 95% confidence interval for the coefficient; *LL* = lower limit of the 95% confidence interval for the coefficient;

UL = upper limit of the 95% confidence interval for the coefficient; t = t-statistic calculated based on the predicted mean; df = small sample corrected degrees of freedom of the distribution of the t-statistic; τ^2 = between-study sampling variance; I^2 = proportion of effect size variance due to between-sample heterogeneity. The comparison group for the gender covariate was samples with combined males and females. Due to an absence of variance, quality was not included as a moderating variable for extraversion.
$p < .05$*, $p < .01$**

Table 3

Uncorrected weighted average effects

Trait					95% CI			Heterogeneity	
	k	***o***	***b***	***SE***	**LL**	***UL***	***z***	τ^2	I^2
Psychoticism	4	8							
Constant			.08	.16	-.23	.40	.52	0	0
Sensitivity to Punishment	3	6							
Constant			-.44**	.17	-.78	-.12	-2.71	0	0
Sensitivity to Reward	3	6							
Constant			.31	.17	-.02	.63	1.84	0	0
Socialization	3	5							
Constant			.15	.19	-.21	.52	.83	0	0
Telic Dominance	3	5							
Constant			-.61**	.23	-1.06	-.16	2.64	0	0
Agreeableness	3	4							
Constant			-.08	.21	-.50	.34	-.36	0	0
Conscientiousness	3	4							
Constant			.13	.21	-.29	.55	.59	0	0
Openness	3	4							
Constant			-.08	.21	-.50	.34	-.39	0	0

Note. k = number of studies; o = total number of comparisons; b = coefficient in the meta-regression model; SE = standard error of the coefficient; 95% CI = 95% confidence interval for the coefficient; LL = lower limit of the 95% confidence interval for the coefficient; UL = upper limit of the 95% confidence interval for the coefficient; z = z-statistic calculated based on the predicted mean; τ^2 = between-study sampling variance; I^2 = proportion of effect size variance due to between-sample heterogeneity.
$p < .05$*, $p < .01$**

Appendix A: Search strategy

1662 articles were found on psychINFO (1890 to April 18, 2017) and 1963 articles were found on sportDISCUS (1892 to April 18, 2017) using the following search strategy:

EXTREME SPORTS
“adventur* physical activit*” OR "adventure sport*" OR "lifestyle sport*" OR "extreme sport*" OR "alternative sport*" OR "action sport*” OR “high-risk sport*" OR skydiv* OR parachute* OR freefly* OR “rock climb*” OR climb* OR mountaineer* OR “ice climb* OR bouldering OR “free solo*” OR “BASE jump*” OR wingsuit OR base OR BMX or “mountain bik*” OR mountainboard* OR skateboard* OR “white water kayak*” OR “scuba div*” OR parkour OR “free runn”* OR ski* OR surf* OR windsurf* OR snowboard* OR “wind surf*” OR kiteboard* OR “cave div*” OR spelunk*

Combined with the Boolean operator “AND”

PERSONALITY:
personality OR “personality trait*” OR “five factor personality model” OR “NEO personality inventory” OR extraversion OR agreeableness OR conscientiousness OR neuroticism OR “openness to experience” OR “sensation seeking” OR “imp* sensation seeking” OR sociability OR activity OR aggression OR “alternative five model” OR “thrill seeking” OR eysenck OR extroverted OR Introverted OR psychoticism OR catell OR perfectionism OR allport OR DE "Personality Traits" OR DE "Adaptability (Personality)" OR DE "Aggressiveness" OR DE "Agreeableness" OR DE "Altruism" OR DE "Androgyny" OR DE "Assertiveness" OR DE "Authenticity" OR DE "Authoritarianism" OR DE "Behavioral Inhibition" OR DE "Catastrophizing" OR DE "Charisma" OR DE "Cognitive Style" OR DE "Conformity (Personality)" OR DE "Conscientiousness" OR DE "Conservatism" OR DE "Courage" OR DE "Cowardice" OR DE "Creativity" OR DE "Cruelty" OR DE "Curiosity" OR DE "Cynicism" OR DE "Defensiveness" OR DE "Dependency (Personality)" OR DE "Dishonesty" OR DE "Dogmatism" OR DE "Egalitarianism" OR DE "Egotism" OR DE "Emotional Immaturity" OR DE "Emotional Inferiority" OR DE "Emotional Instability" OR DE "Emotional Maturity" OR DE "Emotional Security" OR DE "Emotional Stability" OR DE "Emotional Superiority" OR DE "Emotionality (Personality)" OR DE "Empathy" OR DE "Extraversion" OR DE "Femininity" OR DE "Gregariousness" OR DE "Honesty" OR DE "Hypnotic Susceptibility" OR DE "Independence (Personality)" OR DE "Individuality" OR DE "Initiative" OR DE "Integrity" OR DE "Internal External Locus of Control" OR DE "Introversion" OR DE "Irritability" OR DE "Liberalism" OR DE "Likability" OR DE "Loyalty" OR DE "Machiavellianism" OR DE "Masculinity" OR DE "Misanthropy" OR DE "Moodiness" OR DE "Narcissism" OR DE "Need for Approval" OR DE "Need for Cognition" OR DE "Negativism" OR DE "Nervousness" OR DE "Neuroticism" OR DE "Nonconformity (Personality)" OR DE "Nurturance" OR DE "Obedience" OR DE "Objectivity" OR DE "Omnipotence" OR DE "Openmindedness" OR DE "Openness to Experience" OR DE "Optimism" OR DE "Paranoia" OR DE "Passiveness" OR DE "Perceptiveness (Personality)" OR DE "Perfectionism" OR DE "Persistence" OR DE "Pessimism" OR DE "Playfulness" OR DE "Positivism" OR DE

"Psychoticism" OR DE "Rebelliousness" OR DE "Repression Sensitization" OR DE "Resilience (Psychological)" OR DE "Rigidity (Personality)" OR DE "Risk Taking" OR DE "Schizotypy" OR DE "Self-Control" OR DE "Selfishness" OR DE "Sensation Seeking" OR DE "Sensitivity (Personality)" OR DE "Seriousness" OR DE "Sexuality" OR DE "Sincerity" OR DE "Sociability" OR DE "Stoicism" OR DE "Subjectivity" OR DE "Suggestibility" OR DE "Timidity" OR DE "Tolerance"

Appendix B: References of studies in meta-analysis

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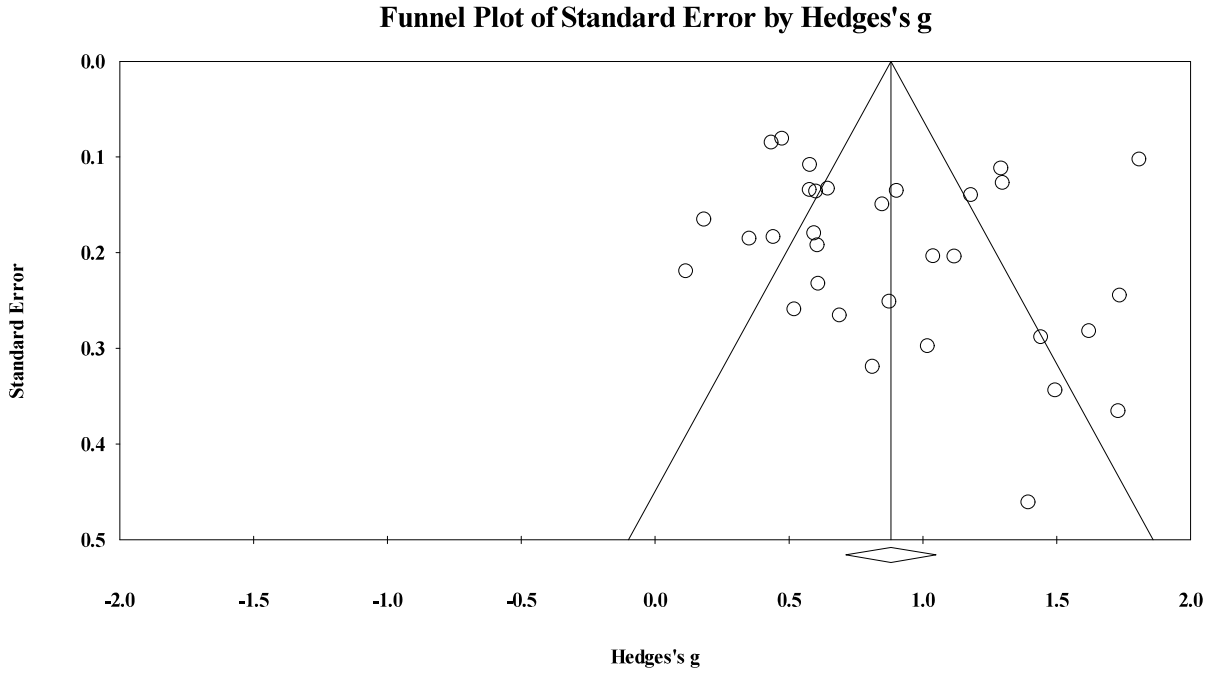
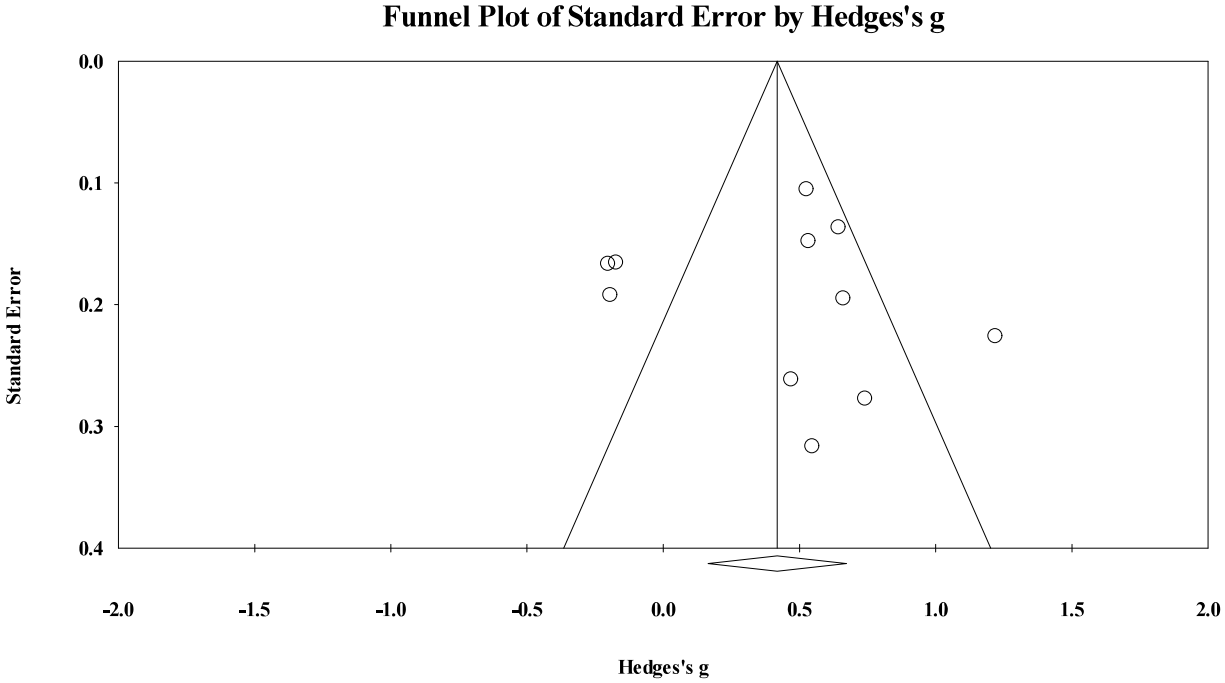
Appendix C: Funnel Plots

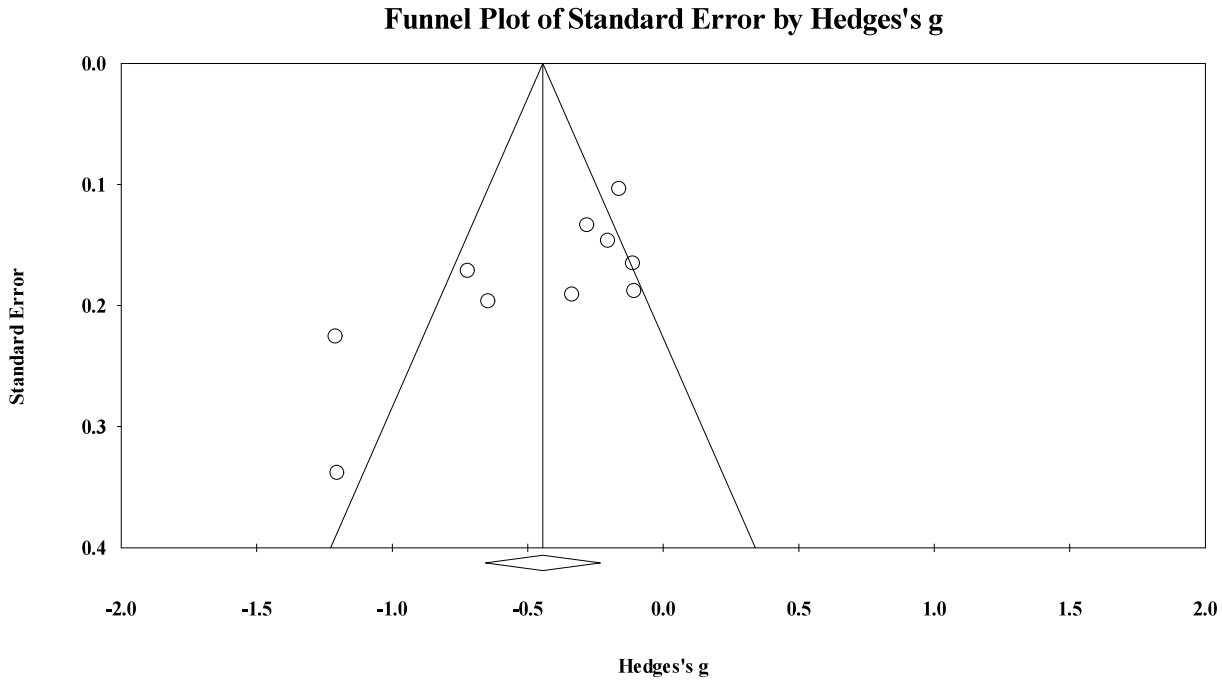
Sensation Seeking



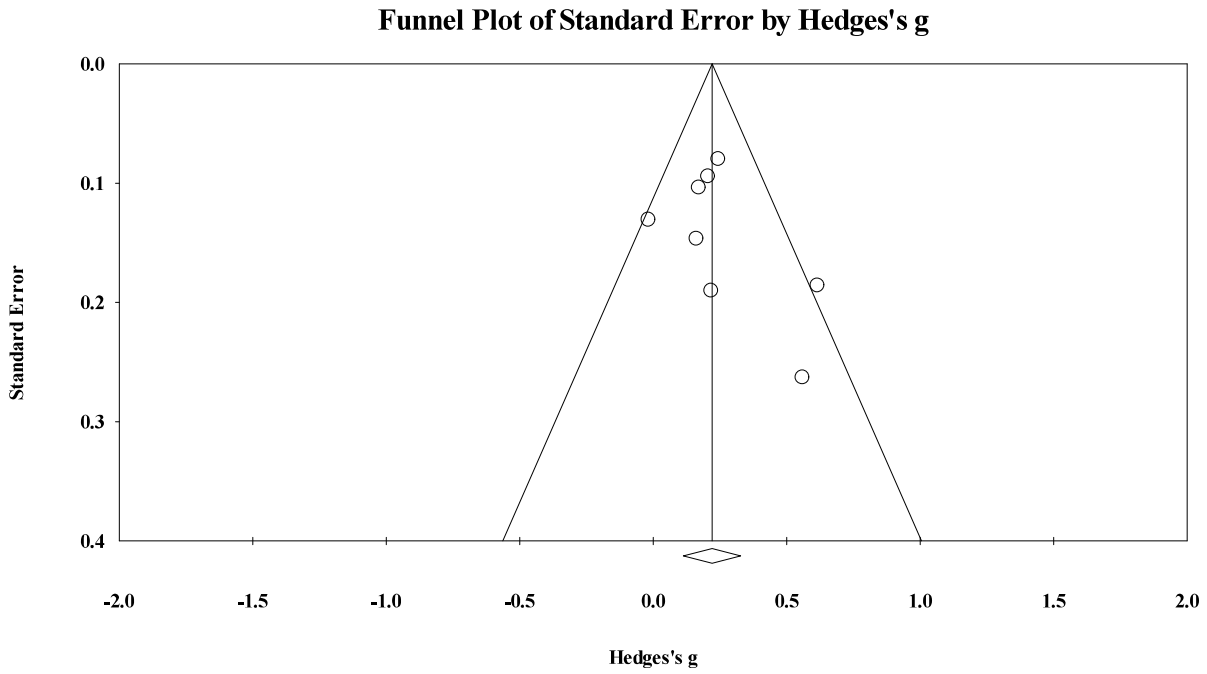
Extraversion



Neuroticism



Impulsivity



PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	Title page, page 2
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	1
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	2-5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4-5
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	n/a
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	5-6, Appendix A
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	5-6
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6-7
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	6-8
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	7-10
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	7

PRISMA 2009 Checklist

Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	7-10

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	9-10
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	9-10
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	10 and figure 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	9-10 and table 1
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	11-14, Table 2-3
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	Table 1
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	11-14, Table 2-3
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	11-14, Table 2-3
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	11-14, Table 2-3
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	14-21
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	18-20
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	20-21
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	Title page

PRISMA 2009 Checklist

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